EQUIPMENT

UDC 666.1.004.3

FACILITIES FOR TRANSPORTING SUPERLARGE GLASS SHEETS IN RAILROAD CARS

V. V. Efremenkov,[1,3] K. Yu. Subbotin,[1] G. S. Nagibin,[2] P. V. Zhurin,[2] and V. L. Khokhlov[2]

Translated from *Steklo i Keramika*, No. 5, pp. 9 – 11, May, 2010.

Questions concerning the preservation of superlarge sheets of glass with dimension 6 × 3 m during shipment in rail cars are examined. The constructions of an A-shaped shipment pyramid and a sealing cover, consisting of a removable cap and two stationary end and two removable side platforms are presented. The removable and stationary platforms that seal the cover also perform the function of mounting traps during loading and unloading of the glass.

Key words: superlarge sheet glass, pyramid, transport, railroad car, sealing cover.

When large volumes of sheet glass are shipped by rail the glass is packed in demountable wooden structures consisting of top and bottom plates and side walls which are strapped by a metallic band and protect the ends parts of the glass from possible mechanical actions and vibrations. However, the substantial dynamical and inertial loads arising during the motion and the coupling of the railroad cars break the clamping of glass packets and cause them to move relative to one another in the horizontal and vertical directions, and this is inevitably accompanied by glass breakage. The losses during shipment by rail range from 10 to 15%.

Other drawbacks of shipping glass in packets are high labor-intensiveness of the process of securing the packets using boards and beams and the high rates of injury occurring when the packets are opened, especially in the bottom part of the railcar. In addition, this method of unloading the finished goods is not intended for transporting large sheets of glass, which is most advantageous for the user because opening of the glass sheets can be optimized and the amount of waste going to cullet during commercial reprocessing can be reduced. Superlarge sheets of glass are mainly shipped by specialized vehicles equipped with means for holding and reliably securing glass sheets with dimensions 6 × 3 m. The cost of delivering a sheet of glass by specialized vehicles is, depending on the shipment distance, 10 – 20% of the price of the product itself; in addition, there exist economic regions where it is impossible to deliver large sheets of glass by vehicle.

AGC Flat Glass Vostok JSC has developed a technology for loading and a means for shipping superlarge sheets of glass by four-axle open railcars with capacity of at least 69 tons (RF Patent No. 85148).

Ordinarily, dismantable A-shape pyramids, in which blocks of sheet glass are placed on both sides at an angle to one another and secured by means of special bearing-retaining devices, are used to transport glass in railcars. Such a structure often results in breakage of the glass when loading and off-loading pyramids as whole and requires additional height in storage facilities and cranes with increased capacity.

The new technology allows placing 12 blocks of sheet glass, each block with dimensions 6000 × 71 × 3210 mm and mass 3.25 tons, on a slightly inclined surface of an A shaped shipment pyramid, tightly secured inside a car and equipped with a special sealing cover, protecting the interior space of the car, the sheet glass, and the pyramid from atmospheric precipitation and unauthorized access.

Stromizmeritel' JSC developed and fabricated a commercial prototype of a sealing cover (RF Patent No. 93507).

The facility for shipping superlarge sheets of glass in railroad cars with a sealing cover operates as follows.

In the initial state, before the sheet glass is loaded, the removable cap *1* (Fig. 1), which covers the top part of the stationary A shaped pyramids *2*, and the two removable side

[1] Stromizmeritel' JSC, Nizhny Novogorod, Russia.
[2] AGC Flat Glass Vostok JSC, Bor, Russia.
[3] E-mail: stromizmeritel@rambler.ru.

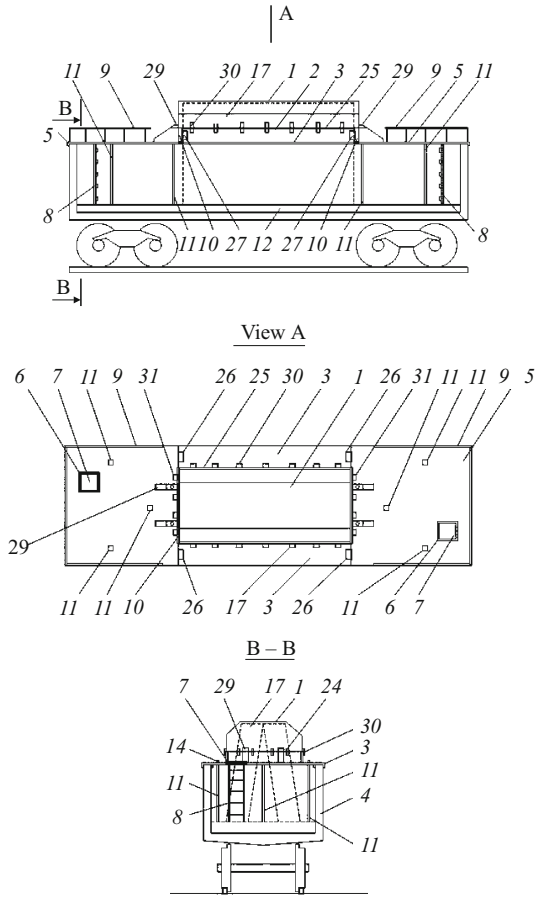

Fig. 1. Overall view of the car with pyramid and sealing cover.

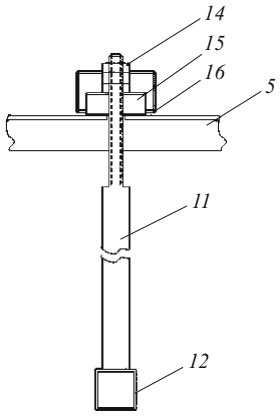

Fig. 2. Securing of the stationary platforms to the car.

platforms *3* were removed from the car *4*, which is located on a special loading platform of the glass stocking area. Two stationary end platforms *5* are placed along the ends of the car and are secured along the car's walls by means of a Ð-shaped frame, made of a channel bar and rubber gaskets. Each stationary platform *5* (Fig. 1, views A and B) is equipped with a port with a locking lid *7*, a ladder *8* for entering the interior space of the car and barriers *9*, and *10*, which provide for the safety of the loading-unloading operations.

The stationary end platforms *5* are rigidly secured by means of vertical tightening devices *11* (three such devices per platform) to longitudinal beams *12* of the base *13* of the pyramid *2*. To decrease the vibrations transmitted from the stationary platforms to the pyramid structure during the motion of the car, the vertical ties *11* are secured to the platforms *5* by means of threaded connections *14* and rubber shock absorbers *15*, protected by removable covers *16* (Fig. 2).

The glass blocks are loaded using a lifting mechanism onto a stationary A-shaped pyramid *2* (Fig. 3) in the car *4*; the base *13* of a pyramid, consisting of transverse and longitudinal beams *12*, is secured by means of threaded connections and rubber vibration dampers to the bottom strapping openings of the railroad platform. With formation of the glass stop *17* the ends of the blocks rest on a layer of rubber of the supports *18*, placed symmetrically on each side of the pyramid, and the flat surfaces of the first blocks touch the cut rubbing walls *19* (Fig. 3, view C). The blocks themselves are covered along their entire length with plastic foam liners. This preserves both the flat surface of the glass and the end sections by smoothing the loads and minimizing the influence of vibrations and shocks during shipment of the glass in railcars.

Once the glass stops *17* have been formed the position of each glass block in a stop is smoothed. The operator going down through the port *6* along the ladder *8* into the interior of the car performs this operation using the bottom mobile *20* and immobile *21* supports placed on the longitudinal beams *12* of the base *13* of the pyramid and equipped with rubber vibration dampers.

The glass blocks are loaded as close as possible to the immobile supports. After the stops of the glass are formed by the mobile supports *20*, equipped with mechanism for being moved manually, the glass stops are secured along the horizontal direction. The rubber vibration dampers on the supports protect the side ends of the glass during mechanical actions on the pyramid when the car is in motion. The stops *17* of the glass on the pyramid *2* are secured by means of vertical supports *22*, equipped with self-evacuating spring suckers *23*, and horizontal tightening devices *24*. For this, the bottom parts of the vertical supports *22* are initially secured on the frame by means of special rotating securing fixtures. Next the operator goes up the ladder *8* and sets the demountable side platforms *3*, equipped with barriers *25*. The demountable side platforms *3* are rigidly secured to the structures of the car by resting the long sides of the platforms on the side walls of the car and the end sides on the structure of the stationary platforms *5*. These platforms are additionally secured by rotating clamping fixtures *26*, connecting the horizontal sections of the stationary and demountable platforms. Similar clamping fixtures *27*, place on the barriers *10*, are connected with the vertical barriers *25* by demountable side platforms *3*.

The side platforms *3* act simultaneously as protective covers and traps, from which the operator secures the glass stops at the top of the pyramid and the connects the vertical

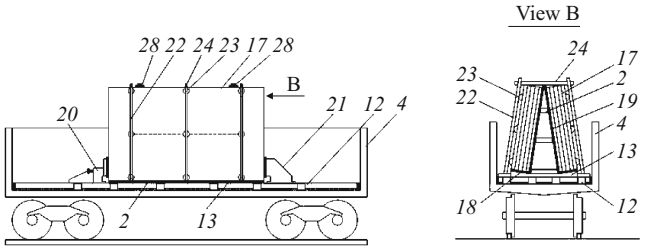

Fig. 3. Longitudinal and transverse sections of a shipment platform with glass.

supports *22* by means of the horizontal tightening connects *24*.

The mechanical tightening force formed by these elements is redistributed over the area of the glass by means of vacuum suckers *23*. The top rubberized supports *28*, which prevent vertical displacement of the glass blocks in the stops when the car is in motion, additionally secure the glass stops along the vertical direction.

The final operation of preparing the pyramid with the glass for shipment on a railcar is the placement of a removable cap *1* on the square base, consisting of two barriers *10* of the stationary platforms *5* and two barriers of the *25* demountable side platforms *3*. The clamping units *17* provide the rigidity of this base.

After the demountable cap *1* is placed precisely on the rectangular base, a cover is secured on the rectangular based by means of latches *30*, placed on the barriers *25* and similar latches *31*, mounted on the barriers *10* of the end stationary platforms *5*.

After the demountable cap *1* has been put into place, the covers *7* of the ports are locked and the glass ready for shipment.

Once the railcar with the glass has reached the user the car is unloaded in the opposite sequence. The car is brought up to the service platform in the stock area, equipped with lifting and transporting equipment (for example, an overhead traveling crane). The clamping latches *30* and *31* are opened and the demountable cap *1* is removed, one or two of the ports *6* are opened. Next the operator, using the stationary and side platforms *5* and *3* as mounting (dismounting) traps, loosens the clamping of the top rubberized supports *28* and disconnects the horizontal ties *24* from the top sections of the vertical supports *22* with the clamping suckers *23*.

Next the clamping units *26* and *27* are opened and the demountable side platforms *3*, acting as traps, are removed using the lifting-transporting mechanism.

The operator goes down the ladder *8* into the interior of the car, disconnects the vertical supports *22* from the fasteners on the base *13* of the pyramid. Then special grips and an overhead crane are used to off-load the blocks with the glass.

In summary, the sealing cover, made in the form of a demountable cap, two stationary and two removable platforms, makes it possible to protect the interior space of the car with the glass from unauthorized access and exposure to atmospheric precipitation during shipment. In addition, the use of stationary and removable platforms as stationary and removable traps with protective barriers facilitates and increases the safety of the glass loading and unloading operations. The fact that there are no rigid connections of the barrier platforms, the demountable cap, and the elements of the pyramid with glass decreases any effects of mechanical shocks and vibrations during shipment of the glass and does not destroy the mechanical integrity of the railcar.

The facility for shipping superlarge sheets of glass in a railcar with a sealed cover has passed commercial prototype tests and has been cleared by the Directorate of the Gor'kii Railroad.

Fourteen additional such cars are being prepared for use.